FALSEWORK REMINDER LIST

I. WHERE TO FIND FALSEWORK INFORMATION

A. Falsework Manual (January 1988) with subsequent revisions.

B. Special provisions

Project specific requirements and considerations.
Requirements for traffic openings. (Section 10)
Railroad requirements. (Section 13)

C. Standard Specifications

5-1.02 Plans and Working Drawings.
7-l.09 Public Safety (includes pedestrian openings).
12-3 Traffic Handling Equipment and Devices (includes K-rail).
49-l.08 Pile Bearing Value.
51-l.06 Falsework.
55-1.05 Falsework (related to steel structures),
86-6.11 Falsework Lighting.

D. Bridge Construction Records and Procedures Manual*

Vol I 2-11.0 Traffic Control (Impaired Clearance).
Vol I 8-7.0 Notice of Impaired Clearance on RR Property.
Vol I 16 Form No. DS-OS-Cl08 (Falsework Clearances).
Vol II 120-1.0 Submitting Falsework Drawings.
Vol II 120-2.0 Impaired Clearance at Traffic Openings.
Vol 11 125-1.0 Lost Deck Forms.
Vol II 125-2.0 Soffit Forms-
Vol II 135-5.0 Mechanical' Anchorage Devices (Permanent work).
Vol II 160-7.0 Stressing Incomplete Bridges.
Vol II 165-4.0 Welded Wire Fabric (For use in PCC pads).
Vol II 180-Var Welding (Permanent work).

E. Cal-OSHA Construction Safety Orders (Sections 1503 & 1717)

F. Division of Structures Falsework Engineer (916-227-8809)

II. PRE-JOB CONFERENCE (SUGGESTED DISCUSSION TOPICS)

A. Falsework Design Review and Approval

1. Review time allowed.
2. Review time starts when a complete submittal is received.
3. Information required for complete submittal. (Refer to "Initial Review" in Chapter 2)
4. For proprietary products, submittal must include technical data (includes hardware items such as overhang brackets, jacks, hangers, etc., and all commercial shoring systems).
5. For cable bracing systems, submittal must include manufacturer's technical data.
6. Determining review duration; falsework review clock.
7. Review time adjustment for design revisions.
8. Priority listing for multiple submittals-
9. Falsework erection cannot begin until drawings are approved.

B. Falsework Erection and Removal Plans

1. Project specific considerations.
2. Show or describe erection and removal procedure on drawings.

C. Traffic Considerations (if applicable).

D. Railroad Involvement (if applicable).

E. Application of Construction Safetv Orders (Sections 1503 & 1717).

*For interdepartmental use only

FALSEWORK REMINDER LIST

III. DESIGN LOADS

A. Vertical Design Loads

1. Minimum vertical design load (dead load plus live load) on any falsework member is 100 lb/ft^2. This includes supports for a construction walkway extending beyond edge of deck.
2. For stress analysis, design dead load is weight of concrete, forms, reinforcing steel and falsework members. Weight of concrete, forms and reinforcing steel is based on assumed unit weight of 160 lb/ft^3 for normal weight concrete or 130 lb/ft^3 for lightweight concrete.
3. For deflection, design dead load is based on actual concrete unit weight.
4. Design live load includes the following:
   (a) 20 lb/ft^2 over the total area supported by the member under consideration.
   (b) 75 lb/LF at edge of deck overhang acting over a maximum of 20 feet. (FW Manual 3-l.04)
   (c) Weight of equipment (finishing machine, etc.) applied as a concentrated load at point of contact.

B. Horizontal Design Load

Greater of the following:
(a) Load due to equipment, construction sequence or other cause, plus appropriate wind load.
(b) 2 percent of the total supported dead load at the point under consideration.

C. Miscellaneous Load Considerations

1. Increased vertical design load at traffic openings.
2. Increased vertical load at hinges due to load redistribution caused by prestressing forces.
3. For structures over flowing water, horizontal load caused by stream flow pressure.
4. Loads due to vertical and horizontal components of cable design loads.

IV. INFORMATION TO BE SHOWN ON FALSEWORK DRAWINGS

A. All Items Listed in "Initial Review" Section in Chapter 2.

B. Anticipated Settlement (not to exceed one inch.)

C. Pads and Piles

l. Assumed soil bearing value for pad foundations.
2. Joint location in continuous timber pads.
3. Design details for concrete pads.
4. For timber piles, design bearing value; tip and butt diameter.
5. For timber pile bents, driving tolerances (maximum Δ and e).
6. Design details for CIDH piles.

D. Dimensions

1. Falsework span lengths (must add up to structure span length).
2. Post and stringer spacing.
3. Vertical distance between connections in diagonal bracing.
4. Height of bents (if needed to check bracing and L/d ratios)*
5. Size of all load supporting members.

E. Timber Bracing
1. Type of connection (single or double shear).
2. Type, size and number of fasteners at each connection.

E. Cable Bracing
1. Number and size of cables in each cable unit.
2. Number and type of connectors (Crosby clips, etc.)
3. Detail showing method or device by which cable will be attached to falsework components, and location of attachment.
4. For external bracing systems, method of cable anchorage.
5. For internal bracing systems, cable preload value and method by which preload force will be applied and measured.

F. Welding and Welded Connections
1. For fillet welds, length and nominal size of weld.
2. For butt welds, welding procedure (to conform to AWS requirements) must be shown on the drawings.

G. Commercial Shoring Systems
For all commercial shoring systems, the trade name and nominal load-carrying capacity (i.e., WACO ll-kip shoring, PAFCO 100-kip shoring, etc.) must be noted on the drawings-

E. Erection and Removal Plans
The method or procedure to be followed, including details for temporary bracing if used, for falsework erection and removal must be shown or described on the drawings.

V. DESIGN CONSIDERATIONS.

A. Plywood
Deflection within limits?

B. Beams and Stringers
1. Joist stresses OK at girder flares, diaphragms and caps?
2. Timber beams stable against buckling and rollover?
3. Steel beams have compression flange supported where necessary?
4. Steel beams checked for bi-axial bending?
5. Camber strips centered on stringers and OK for compression?
6. Beam deflection limited to L/240 under weight of concrete only?
7. For continuous beams, effect of beam continuity checked? beam uplift prevented?

C. Posts and Columns
1. Timber post L/d checked; allowable stress reduced if necessary?
2. Timber post splices meet criteria in FW Memo 8?
3. Steel post L/r checked; allowable stress reduced if necessary?

D. Bracing
1. Diagonal bracing (members and connections) meets Chapter 5 criteria?
2. Timber members adequately sized to accommodate number of fasteners required?
3. Fastener capacity values adjusted for load duration?
4. Proper connection at center of crossing X's?
5. For steel bracing, welded connections meet applicable design criteria? (FW Manual 4-4.08)
6. For cable bracing, manufacturer's technical data reviewed? Load test performed if required?
7. For cable bracing, cable attached to falsework cap, not posts or columns? cable anchorages checked for uplift?

to falsework cap, not posts

E. Deck Overhangs
1. Minimum vertical load (100 psf) on construction walkways?
2. Load reduced for falsework spans exceeding 20 feet? (FM Manual 3-1-04.)
3. Differential beam deflection considered? (FW Manual 3-3.06)
4. Additional requirements for deck overhangs on steel girder bridges considered? (FW Manual 3-3.07)

F. Foundations
1. Assumed pad soil bearing value compatible with site conditions? wet or dry conditions? soil load test required?
2. Pad joint location meets design criteria? (FW Manual 7-2.05)
3. Bearing adequate at post/corbel interface? steel plates required?
4. For multiple-corbel systems, spacing OK? (FW Manual 7-2.03C)
5. Bearing on timber piles not over 45 tons?
6. Additional considerations for timber pile bents
   . Driving tolerances reasonable?
   . Required penetration realistic?
   . Bracing meets design criteria?
   . Horizontal deflection considered?
   . P-delta deflection considered?
   . Longitudinal stability adequately addressed?

G. Commercial Shoring Systems
1. Currently approved systems (as of 06/95)
   (a) Pipe-frame systems
      . WACO
      . PATENT
      . Burke-Aluma
   (b) Intermediate strength systems
      . WACO
   (c) Heavy duty systems
      . PAFCO
      . WACO
      . WADC0
      . Hi-Cap
2. Manufacturer's technical data furnished and reviewed?
3. Design loads comply with manufacturer's recommendations for all loading conditions?
4. Shoring design in accordance with manufacturer's recommendations and falsework manual design criteria? (See Chapter 6)
5. Cable bracing, if used, connected to cap at top and to external support at bottom? (If not so connected, manufacturer's statement of authorization is required.)
6. Cable design load meets falsework manual criteria?

H. Longitudinal Stability (FW Manual 5-l.04)

1. Overturning Stability (FW Manual 5-1.05)

J. Erection and Removal Plans
1. Falsework components stable during all stages of erection and removal?
2. If used, temporary bracing (including connections) meets minimum design load criteria? (Wind load is minimum design load.)
3. For removal see "CONSTRUCTION CONSIDERATIONS"

K. Miscellaneous Considerations
1. Method of grade adjustment
   . Adequate jacking space?
   . Sufficient bearing area on wedge surfaces?
   . Sand jack integrity assured?
2. Use of friction to resist horizontal forces. (FW Manual 3-3.03; FW Memo 5 for C-clamps)
3. For falsework at hinges, load redistribution due to application of prestressing forces. (FW Manual 3-3.04)
4. Proprietary products used in accordance with manufacturer's recommendations?manufacturer's technical data furnished and reviewed? (Manufacturer's technical data is required for all proprietary products used in the falsework, and for all cable installations.)
5. Lost deck falsework. (See FW Manual 4-2.03D & 9-l.09)

VI. ADDITIONAL DESIGN CONSIDERATIONS AT TRAFFIC OPENINGS

A. Clearances
1. Check Horizontal (H) and Vertical (V) Clearances:

Traffic:	FW Plans: H_____	V_____
	Specials: H_____	V_____
Pedestrian:	FW Plans: H_____	V_____
	Specials: H_____	V_____

2. Openings conform to District requirements?
3. Vertical clearance sign required? (For vertical clearance, consider beam deflection and post settlement. Sign required for vertical clearance less than 15 feet.)
4. K-rail length and clearance to falsework OK? (For minimum K-rail clearance to falsework see FM Manual Figure 8-1.)

B. Design requirements for Posts Adjacent to Roadways
1. Minimum section modulus about each axis:
   For steel posts $S_{Min.} = 9.5\ in^3$
   For timber posts $S_{Min.} = 250\ in^3$.
2. Post design load is greater of:
   (a) 150 percent of normal post loading.
   (b) Increased or readjusted loads caused by prestressing forces and/or cable bracing or tiedowns.
3. 5/8" diameter or larger bolts used at connections for both ends of timber bracing; appropriate connections for cable bracing.
4. Mechanical connections to resist impact.
   . 2000 lb capacity for post-to-sill-to-base connections effective in all directions except toward the roadway.
   . 1000 lb capacity for cap-to-post connection effective in any direction.
   . 500 lb capacity for certain stringer-to-cap connections effective in all directions including uplift.

C. Falsework Lighting (Standard Specs. 86-6.11)
1. Lighting Plan
   . Included with falsework drawing submittal?
   . Separate submittal?
2. Portal lighting and white panels.
3. Roadway illumination. (Standard Specs. & special provisions)
4. Pedestrian walkway lighting, if applicable.

D. Pedestrian Openings (Standard Specs. 7-1.09)
1. Paved passageway or wooden walkway?
2. Handrail per Cal-OSHA requirements?
3. Overhead debris protection?
4. Lighting adequate?

VII. RAILROAD REQUIREMENTS (See FW Manual 2-1.06B)

A. General
1. Project specific railroad requirements are found in Sections 10 and 13 of the special provisions.
2. Working drawings for construction features affecting railways are to be approved by the Railroad Company involved prior to approval by the Structure Representative.

B. Clearances (See special provisions for minimum clearance requirements. Planned clearances must be shown on FW drawings.)
1. Check Horizontal (H) and Vertical (V) Clearances
FW Plans: H_____ V_____
Specials: H_____ V_____
2. Vertical clearance measured from top of rail. (For minimum clearance, consider beam deflection and settlement.)
3. Horizontal clearance measured from centerline of tracks.

C. Design Requirements for Posts Adjacent to Railroads
1. Minimum section modulus about each axis:
For steel posts $S_{Min.} = 9.5\ in^3$
For timber posts $S_{Min.} = 250\ in^3$.
2. Post design load is greater of:
(a) 150 percent of normal post loading.
(b) Increased or readjusted loads caused by prestressing forces And/or cable bracing or tiedowns.
3. 5/8" diameter or larger bolts used at connections for both ends of timber bracing; appropriate connections for cable bracing.
4. Mechanical connections to resist impact.
. 2000 lb-capacity for post-to-sill-to-base connections effective in all directions except toward the railroad track,
. 1000 lb capacity for cap-to-post connection effective in any direction.
. 500 lb capacity for stringer-to-cap connections effective in all directions including uplift.

D. Bents Within 20 Feet of Track Centerline
1. Solid sheathing (5/8-inch plywood or l-inch nominal thickness lumber) between 3 and 17 feet above track on track side of bent. (Atchison, Topeka and Santa Fe Railway Company may want chain link fencing in lieu of sheathing on Amtrak lines.)
2. Bracing designed to resist the horizontal design load, but not less than 5000 pounds.

E. Collision Posts
Show location on general plan sheet for Southern Pacific Transportation Company only. (Optional for other railroads.)

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VIII. FALSEWORK DRAWING APPROVAL

A. General

1. "Plan Approval" stamp on each sheet, signed by structure representative or by staff member who actually reviewed the design and is a registered civil engineer.
2. Approval letter signed by structure rep. (FW Manual 2-1.06A)
3. Plan distribution when railroad not involved
   . One set to contractor, with approval letter.
   . One set to Sacramento office, with copy of engineer's calcs.
   . One set retained in job files, with engineer's calcs.
   . Remaining sets for field use.

B. Procedure When Railroad Company is Involved

1. DO NOT APPROVE DRAWINGS UNTIL NOTIFIED BY SACRAMENTO OSC THAT DRAWINGS ARE SATISFACTORY TO THE RAILROAD.
2. After review of drawings, send drawings and calculations to Sacramento with a cover memo; memo to include the following information:
   . Name of railroad company
   . County, route, and post mile
   . Contract number
   . Bridge name and member
3. See "Procedure when Railroad Company Approval is Required" in Chapter 2 for number of sets of drawings and other information pertaining-to falsework drawing approval on railroad projects.

XI. CONSTRUCTION CONSIDERATIONS

A. Falsework Erection Plan

Before falsework erection begins, review erection plan with State and contractor personnel. (FW Manual 9-1.02)

B. Pad Foundations

1. Foundation material adequate to support design soil pressure? soil bearing test needed? (Appendix B includes information on soil bearing values and soil load testing.)
2. Splices in continuous pads located properly? If not, is pad redesign required?
3. Pads protected from flooding and surface runoff?

C. Pile Foundations

1. Required pile bearing value obtained?
2. For pile bents, penetration and driving tolerances meet design assumptions? If not, is redesign required?

D. Timber Construction

1. Timber quality OK for design stresses?
2. Connections conform to design details? connectors properly installed?
3. Workmanship adequate? (FW Manual 9-l.04B)

E. Manufactured Assemblies

l. All commercial products and devices used and installed in accordance with manufacturer's recommendations?
2. Contractor's certification furnished?

FALSEWORK REMINDER LIST

F. Metal Shoring Systems
   1. Assembly meets industry standards? (FW Manual 9-l.07)
   2. Contractor's certification furnished?
   3. If components from different systems are intermixed, has contractor furnished letters of approval from each manufacturer whose system is used? (FW Manual 9-l.07)

G. Cable Bracing
   1. Cable is same size and type shown on falsework drawings?
   2. Connections conform to falsework drawing details?
   3. Crosby clips properly installed and torqued?
   4. For internal bracing systems, preload force applied? preload force applied twice for cables attached to timber members?

H. Traffic Openings
   1. Clearance notification
      . Notify resident engineer and/or District permits engineer of minimum vertical clearance not less than 2 weeks before falsework erection begins.
         CRAP Manual -- Vol I Section 2-11.0
         CRAP Manual -- Vol II Section 120-2.O
      . Re-notify after erection if actual clearance is different.
   2. White panel boards properly positioned?
   3. Portal lighting inspected after dark?

I. Field Changes
   1. All changes documented?
   2. For substantial changes, revised drawings submitted for approval? (FW Manual 9-1.12)

J. Certification by Registered Engineer (FW Manual 9-l.13)

K. Inspection after Concrete Placement (FW Manual 9-l.15)

L. Falsework Removal
   l. Falsework removal plan reviewed with State and contractor personnel? (FW Manual 9-1.16)
   2. Falsework components stable during all stages of erection and removal?
   3. Effect of temporary unbalanced and/or eccentric loads, effect of jacking loads, and effect of crane set on the permanent structure all considered?
   4. For removal using winches set on deck, winch load adequately distributed?
   5. For stage construction, effect of removal sequence considered? (FW Manual 3-3.05 & 9-1.16A)